

# Evaluation of spraying time and cobalt nanoparticle fertilizer using chemical and green chemistry methods on morphophysiological indices of cowpea (*Vigna unguiculata* L.)

## Abstract

in order to evaluation of the spraying time and cobalt nanoparticle fertilizer using chemical and green chemistry methods on morphophysiological indices of cowpea, this research in the 2017-18 crop year as factorial experiment in a randomized complete block design with three replications was done at Agricultural Research Institute of Zabol University. Experimental treatments in 4 levels including non-use of nanoparticles (control), cobalt nanoparticles of plant origin, cobalt nanoparticles of chemical origin and the combination of Green and chemical nanoparticles as the first factor; and spraying time on 2 levels includes 4-leaf stage and 6-leaf stage, as the second factor. The results of the analysis of variance of the data obtained from the experiment showed that interaction effects of cobalt nanoparticle fertilizer levels and spraying time on all studied traits except for leaf iron, it was significant and leaf iron it was only affected by the spraying time of the cobalt nanoparticle fertilizer. The interactions of mean's comparison showed that the highest plant height (65.26 cm), biological yield (3816 kg.ha<sup>-1</sup>), grain yield (1416 kg.ha<sup>-1</sup>), number of pod per plant (11.8 No.), hundred grains weight (14.5 g), in spraying time of 6-leaf stage from nano-fertilizer of plant and chemical origin treatment; and highest harvest index (43.13%), and the number of grains per pod (10.01 No.) in spraying time of 6-leaf stage from nano-fertilizer of Green and chemical origin treatment. Furthermore, the highest leaf nitrogen (2.49 ppm), carotenoid (3.63 mg.l<sup>-1</sup> fresh leaf weight), chlorophyll a (1.34 mg.l<sup>-1</sup> fresh leaf weight), chlorophyll b (0.654 mg.l<sup>-1</sup> fresh leaf weight), and the highest spade index (26.72) in spraying time of 4-leaf stage from nano-fertilizer of plant and chemical origin treatment. Also, the highest seed nitrogen (7.4 ppm), was observed in the spraying time of 4-leaf stage from nano-fertilizer of Green and chemical origin treatment. Furthermore, the highest leaf iron (0.26 ppm), and the highest leaf protein (14.93 mg.l<sup>-1</sup>) was obtained in the spraying time of 6-leaf stage from nano-fertilizer of plant origin treatment. Also, the highest seed protein (44.19 mg.l<sup>-1</sup>) was obtained in the spraying time of the 6-leaf stage from control (non-use of nanoparticles) treatment. According to the results application of spraying time of 6-leaf stage from nano-fertilizer of plant and chemical origin, treatment is recommended for cowpea cultivation in the area.

**Keywords:** Pulses crop, Cobalt Micro elements, Yield, Chlorophyll a , Protein



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